



NOAA's National Centers for Coastal Ocean Science

Accomplishments: 2006



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Photo credit (front cover): John Crofts

The Director

While this Accomplishments Report highlights the efforts of NOAA's National Centers for Coastal Ocean Science (NCCOS) staff during fiscal year (FY) 2006, producing world-class coastal and ocean science requires much more time from start to finish. It often takes months, or even years, to identify the methods, perform the research, and produce a product or service needed by coastal managers and other customers. Additional fine-tuning of the product or service ensures that it meets the customer's needs and helps solve real-world challenges. Thus, the reality is that this year's NCCOS Accomplishments Report highlights major accomplishments for which seeds were planted months, or even years, ago. The products and services highlighted here reflect extensive collaboration with our partners and customers in coastal areas across the country and around the world.

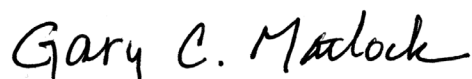
By any reasonable measure, we've accomplished a lot this year. None of NCCOS' accomplishments would be possible without exceptional staff and state-of-the-art facilities in which to perform research and technology development. The new nuclear magnetic resonance facility at the Hollings Marine Laboratory in Charleston, South Carolina is allowing NCCOS scientists and their partners to study the complex interactions of how the oceans affect humans and how humans affect the oceans. In addition, the new library, teaching laboratory, and auditorium in our Beaufort, North Carolina center are the result of a successful and long-term NCCOS partnership with state and community interests.

I invite you to learn more about our efforts to build capacity among governmental, private, tribal, academic, and public stakeholders to be better stewards of the coastal resources on which their health and welfare depend. You can also learn about NCCOS' efforts to integrate the human dimensions of ecosystems – the human causes, consequences,

and responses to ecosystem stress – into decisionmaking processes about coastal and ocean resources. This report highlights the extraordinary progress we've made in forecasting the Gulf Coast's infamous "dead zone," where low oxygen levels harm and kill marine invertebrates, fish, and plants across an area the size of Maryland, as well as forecasting the movement of and potential risks from harmful algal blooms off the coast of Florida – information critical to managing and reducing those risks.

NCCOS' accomplishments and ongoing efforts reflect our strategic goals and objectives to provide coastal managers, other decisionmakers, and stakeholders with the scientific information and tools needed to balance society's environmental, social, and economic goals. These goals and objectives are outlined in the NCCOS Strategic Plan, which can be found at: <http://coastalscience.noaa.gov/documents/strategicplan.pdf>.

As with all of its products, NCCOS is interested in determining the value of this effort. We encourage you to provide feedback using the contact information at the end of this report, and assure you that your feedback will be appreciated in directing our future efforts to help protect coastal and ocean resources.



Gary C. Matlock, Ph.D.

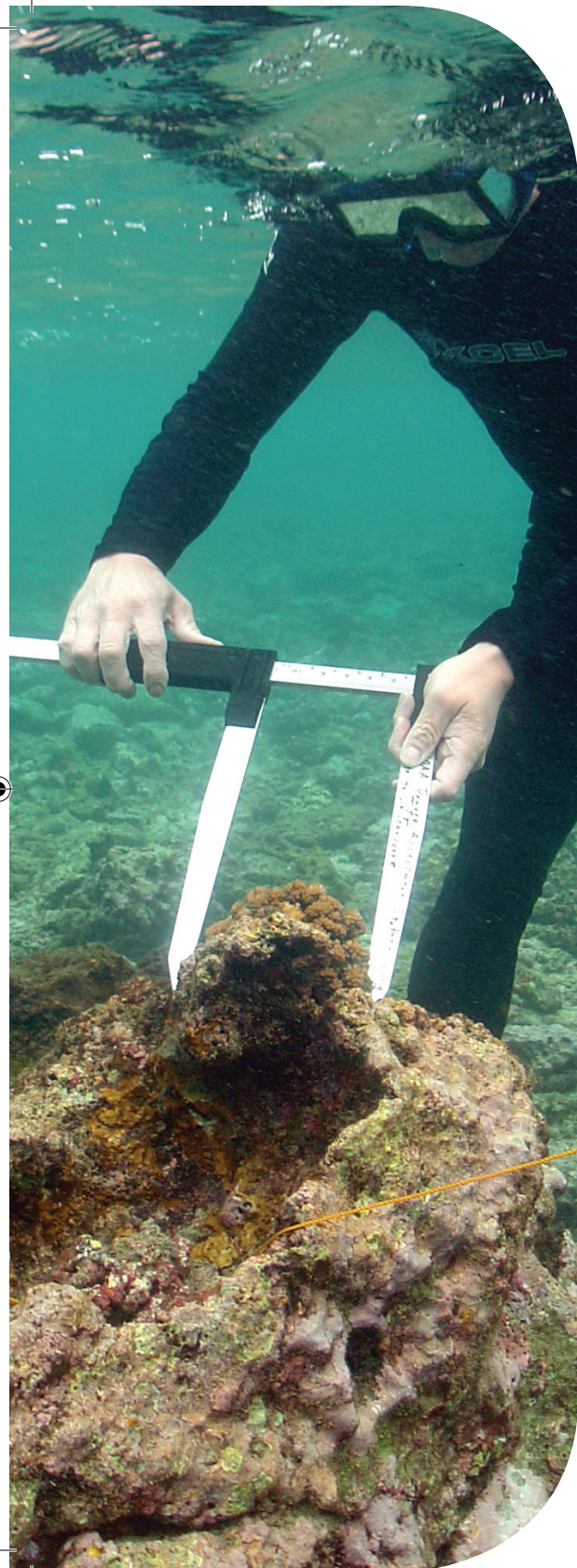


Photo credit: Doug Helton

ABOUT NCCOS

The National Oceanic and Atmospheric Administration (NOAA) formed the National Centers for Coastal Ocean Science (NCCOS) in February 1999 as the focal point for NOAA's coastal ocean science efforts. NCCOS conducts and supports research, monitoring, and assessments and provides technical assistance to meet NOAA's coastal stewardship and management responsibilities. NCCOS provides coastal managers with the scientific information they need to decide how best to protect environmental resources and public health, preserve valued habitats, and improve the way communities interact with surrounding ecosystems. NCCOS collects, synthesizes, and converts scientific research results into relevant data and products that managers can use to make more informed decisions. By providing relevant and timely information and creative approaches for examining environmental issues, NCCOS strengthens the linkage between sound science and management.

Society benefits when coastal stewardship decisions are guided by sound science. For NCCOS, this vision translates into the following core operating principles:

- Deliver high quality science in a timely and consistent manner using productive and strong partnerships;
- Develop and maintain relevant research, long-term data collection and analyses, and forecasting capabilities in support of its customers, stakeholders, and partners;

- Build capacity in the private, local, state, and tribal sectors by transferring technology, and by providing technical assistance and knowledge to its customers and partners;
- Conduct the anticipatory science necessary for managing the potential impacts of multiple stressors on coastal ecosystems; and
- Provide the best possible work environment for each employee by treating each individual with fairness, respect, and recognition, and with adequate training in the safest facilities and with the most current equipment possible.

NCCOS emphasizes the social, economic, and political aspects of its work to better understand human contributions to and consequences of ecosystem stress, and to improve the management of societal goals, governance of large marine ecosystems, and recovery of communities from coastal hazards. Working with its partners, NCCOS has developed a human dimensions strategic plan and provides the results of human dimensions research to improve coastal restoration monitoring, harmful algal bloom (HAB) mitigation, fisheries management, and coral reef ecosystem management. NCCOS also transfers technologies and methods to its international partners, thereby reflecting NOAA's global leadership on environmental issues.

Focus on Ecosystems

NCCOS focuses its research on four categories of ecosystems that NOAA and its partners manage – coral reefs; National Marine Sanctuaries; estuaries, including National Estuarine Research Reserves (NERRs); and coastal oceans. The benefits of these valuable, yet at-risk, ecosystems include diverse biological resources and habitats, research and recreational opportunities, and a wealth of commercial fish and shellfish.

Coral Reefs

Among the most diverse and productive ecosystems on Earth, coral reefs are rich in biological diversity and cultural heritage. In the U.S. and internationally, these ecosystems are under stress from a combination of human activities and natural causes, including overfishing, disease, pollution, climate change and coral bleaching, and tropical storms. NCCOS research helps coastal managers decide how best to protect these fragile ecosystems by helping them establish appropriate geographic boundaries for marine protected areas and determine the most effective regulations for commercial fishing, recreational uses, pollutant discharges, and coastal development. NCCOS also conducts and maintains inventories, develops maps, and monitors coral reef ecosystems using innovative technologies that reduce management costs and improve speed and accuracy. In addition, NCCOS is leading a partnership effort to systematically produce digital benthic habitat maps for all shallow-water U.S. coral reef ecosystems by 2010. NCCOS also sponsors the Hawaii Coral Reef Initiative and National Coral Reef Institute, and is the lead partner in the U.S. Coral Reef Task Force's Coral Disease and Health Consortium.

National Marine Sanctuaries

National Marine Sanctuaries are marine areas set aside either administratively or by an Act of Congress based on their ecological integrity, biological diversity, and natural and cultural resources. The 14 Sanctuaries include deep-ocean "gardens," nearshore coral reefs, whale migration corridors, deep sea canyons, and underwater archeological sites in the Pacific and Atlantic Oceans, the Great Lakes, and off the coast of American Samoa. NCCOS scientists partner with Sanctuary managers to achieve preservation goals by providing comprehensive assessments of current conditions through the mapping of benthic habitats, monitoring of environmental changes and natural events, and researching of contaminant amounts and sources.

Photo credit: John Stevenson



Photo credit: Emerys Hall and Jordan

Estuaries (including National Estuarine Research Reserves)

Spanning more than 4.5 million acres of U.S. coastline, estuaries are semi-enclosed bodies of water where freshwater and ocean tides connect, and are some of the most biologically productive ecosystems on Earth. The National Estuarine Research Reserve System is a network of 27 estuarine areas protected for long-term research, education, and stewardship through partnerships between NOAA and coastal states. NCCOS scientists examine links between human activities and the increasing number of ecological disturbances that can threaten productivity of estuaries. The NCCOS-sponsored National Status and Trends Program, which monitors sediment toxicity in estuaries nationwide, is the longest continuously running monitoring program in the world.

Coastal Oceans

The coastal oceans that form the U.S. Exclusive Economic Zone extend 200 miles offshore and encompass a broad range of saltwater ecosystems – including estuaries, coral reefs, rocky shores, gravel shores, sandy shores, mud flats, marshes, and mangrove forests. At least two-thirds of the Nation's commercial fish and shellfish use these ecosystems as spawning grounds and nurseries. Coastal oceans also provide many recreational opportunities that contribute to the economic well-being of local communities. NCCOS' research improves the understanding of large-scale processes affecting coastal oceans and helps protect and restore coastal ocean resources through ecosystem-based management.

Focus on Ecosystem Stressors

NCCOS focuses on five categories of human and natural "stressors" impacting coastal ocean ecosystems: climate change, extreme natural events, pollution, invasive species, and land and resource use. Understanding how these stressors affect ecosystems is vital to assess impacts to coastal communities and manage our Nation's ocean and coastal resources.

Climate Change

There is a scientific consensus that the Earth's air and oceans are warming, and that sea level will rise over the coming century. Given uncertainties about the degree of warming and how coastal zones and marine life will respond to the changes, scientists are striving to improve the understanding of both natural and human causes of climate change. NCCOS conducts multidisciplinary research to better understand and forecast the longer-term impacts of climate change and climate variability. Such impacts include changes in relative sea level and coastal storms which may affect the sustainability of coastal communities and wetlands; changes in precipitation and freshwater flow which may affect nutrient and salinity levels; and changes in ocean temperature, circulation, and carbon dioxide concentrations which may affect the sustainability of sensitive species and ecosystems, such as coral reefs.

Extreme Natural Events

Storms, floods, droughts, and phenomena such as HABs have profound effects on coastal ecosystems and the people living and working near them. HABs, which can wreak havoc on local economies and threaten human health, occur in nearly every coastal and Great Lakes state, causing an estimated \$1 billion in economic losses over the past few



Photo credit: Doug Helton

decades. NCCOS builds upon NOAA's extensive forecasting capabilities to help lessen environmental and social impacts of extreme natural events by emphasizing rapid response to emergencies and long-term planning efforts to mitigate future adverse impacts. As part of an interagency effort to assess the environmental impacts of Hurricanes Katrina and Rita, NCCOS scientists are monitoring and assessing current and long-term concentrations of human pathogens and chemical contaminants in coastal waters, fish, shellfish, and sediments. In addition, NCCOS' Mussel Watch Project is serving as a baseline with which to compare post-hurricane data to its 20-year series of data for 120 contaminants at more than 300 sites nationwide.

Pollution

Marine organisms can accumulate chemical and other contaminants in their tissues from water, sediments, and food, and may experience adverse biological effects even from extremely low concentrations of pollutants. Increased nutrient loadings can lead to excessive production of algae, which decompose and reduce oxygen concentrations in bottom waters, often to levels at which fish and other organisms cannot survive. NCCOS' annual forecasts of the Gulf of Mexico hypoxic zone help managers better understand the impacts of such hypoxic events on fisheries. NCCOS scientists continue to compile data on chemical contaminant levels in many U.S. estuaries and are using the historical data collections to determine how best to address chemical contaminants in coastal watersheds. NCCOS is also collaborating with Federal and academic researchers to identify chemical and biological stressors that may pose environmental and homeland security threats.



Photo credit: Paul Taylor



Photo credit: Estrella Marca

Invasive Species

Exotic plants and animals brought to the U.S. from other countries – or moved to new areas from within the U.S. – can damage native plants and animals, lead to undesirable changes in native community structure, and cost millions of dollars for management and control measures. U.S. marine and coastal environments, already under stress from other factors, are particularly susceptible to risks posed by the introduction of non-native species. The resulting changes in species composition often can be dramatic and difficult to predict. Through its invasive species research and monitoring activities, NCCOS provides technical assistance and complex data analyses to a growing network of partners who use the information to plan and implement effective local prevention and control strategies.

Land and Resource Use

Increasing domestic and international demands for food, fiber, and space are accelerating changes in land and resource use, resulting in exhausted fisheries, habitat loss, degraded water quality, and increased chemical and sediment runoff. These conditions are found throughout the U.S. and are among the most challenging problems facing coastal managers. Increased understanding of the consequences of human uses of land and resources will allow for better balancing of economic demands with environmental sustainability. NCCOS conducts and supports research on specific causes and effects of land and resource use on coastal ecosystems. Of particular concern to NCCOS are land and resource issues within those ecosystems managed directly and indirectly by NOAA.

New and Updated Capacities

New facilities and major upgrades have added safety and technological capacities that support a broad range of research efforts conducted by NCCOS scientists and their partners which are providing the science necessary for sound management decisions.

New Aquaculture System Cuts Costs and Environmental Impacts

NCCOS scientists designed an innovative, cost-effective, and environmentally-friendly automated seawater system. Through the application of sonar and pressure sensor technology, the new system at NCCOS' Center for Coastal Fisheries and Habitat Research monitors demand and limits seawater flow to what is needed, thereby saving millions of gallons of unnecessarily pumped seawater and over \$12,000 in annual electrical and maintenance costs. In addition, the new automated backup capabilities limit the loss of heavily invested experimental organisms that support a number of projects. The previous system design, typical of most aquaculture operations, did not match flow rate with demand, thereby resulting in wasteful pumping of unused seawater, wasted electricity, increased operational and maintenance costs, and less reliability.

Integrated Research and Education Enterprise in Alaska Builds on Local Expertise, Provides Job and College Opportunities

Based on efforts by NCCOS and the University of Alaska at Fairbanks, rural Alaskans are now able to earn college credit transferable to the University for their practical experience at NCCOS' Kasitsna Bay Laboratory in Alaska, thereby integrating local scientific expertise and increasing educational and employment opportunities. Both organizations are financially supporting this integrated research and education enterprise and are benefiting from the newly-constructed laboratories, dormitory, and scuba facilities at the lab.

NCCOS Research Vessel Converted to Use Environmentally-friendly Fuel

NCCOS helped fulfill NOAA's commitment to environmental stewardship by converting one of its research vessels, *R/V Hildebrand*, to use biodiesel fuel, an environmentally-friendly fuel substitute usually made from vegetable oil that is non-toxic, biodegradable, and has fewer emissions than petroleum-based diesel. The hydraulic system and engine crankcases contain biologically-derived lubricants. The benefits were immediately noticeable after its first post-conversion mission as the typical diesel exhaust smell and smoke did not exist. The conversion also supports the Code of Environmental Management Principles for Federal Agencies and Executive Order 13148 ("Greening the Government through Leadership in Environmental Management").

Photo credit: Doug Helton

Through the use of environmentally-friendly fuel, we're reducing employee health risks and putting less toxic material into the marine environment.

— Roger Mays, NCCOS' Center for Coastal Fisheries and Habitat Research

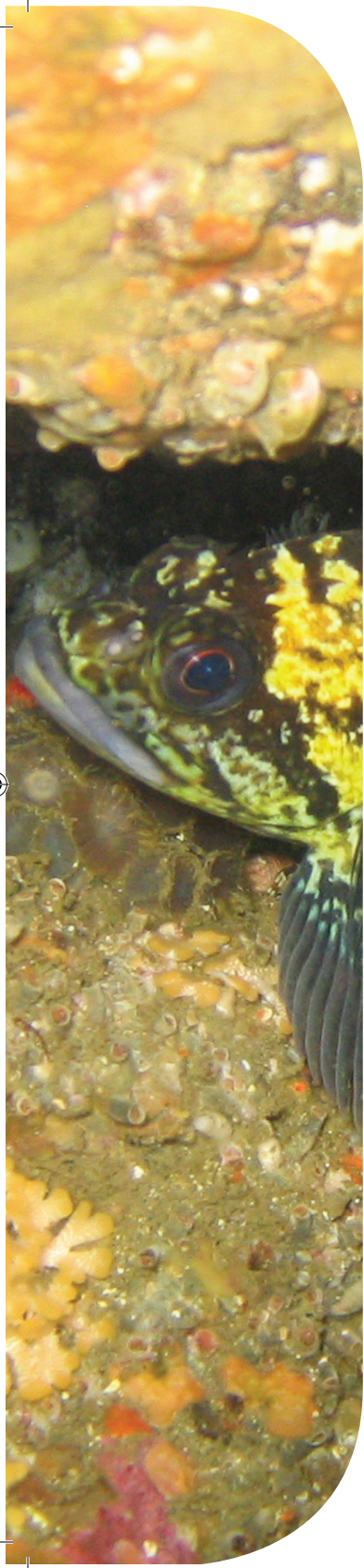


Photo credit: John Crofts



Photo Credit: NOAA Educational Partnership Program

New Cooperative Agreement Enhances NOAA's Diverse Workforce and Increases Collaborative Research with Minority Serving Institutions

A cooperative agreement among NOAA and eight educational institutions was funded in September 2006 to continue support for the Environmental Cooperative Science Center, an education and research science center focused on students from underrepresented populations in NOAA-related sciences. The five-year agreement helps NOAA recruit postgraduate minority students as its next generation of scientists and enables NOAA and NERR scientists to work collaboratively with students, faculty, and researchers from the Center's institutions (Florida A&M University, Delaware State University, Creighton University, Jackson State University, Morgan State University, Texas A&M University-Corpus Christi, the University of Miami, and the University of Nebraska at Lincoln). The agreement also helps fulfill the U.S. Commission on Ocean Policy's call to increase participation of traditionally underrepresented and underserved groups in the ocean-related workforce.

New State-of-the-Art Instruments at Hollings Marine Laboratory to Help Protect Ocean and Human Health

In FY 2006, two state-of-the-art instruments were installed at NCCOS' Hollings Marine Laboratory to enable scientists to relate molecular-scale information to complex ecosystem issues. The nuclear magnetic resonance instruments are unique in non-medical facilities and will help NCCOS and its partners perform collaborative research to serve the public interest. Specifically, scientists will now be able to study how marine organisms respond to chemicals and other stimuli to advance the knowledge base of contaminant chemistry. This new knowledge will improve management decisions concerning the assessment and mitigation of these impacts. Senator Ernest Hollings paid an impromptu visit to the lab – one of NOAA's three Centers of Excellence for Oceans and Human Health – in February 2006 to see the installation of the two new instruments.

New NCCOS Building in Beaufort, North Carolina to Increase Opportunities for Public Interaction, Collaborative Research

NCCOS' Center for Coastal Fisheries and Habitat Research broke ground on a \$4 million building in December 2005. The new building will include shared space for government and public functions, including an auditorium, live stream broadcast studio, library, and teaching laboratory. This building – the result of an agreement between NCCOS and the North Carolina Department of Environment and Natural Resources, Division of Coastal Management – is the first new facility built on Pivers Island by the government in more than 40 years. This Center is the second oldest Federal marine laboratory in the U.S., established in 1899 by the U.S. Fish Commission and reorganized under NOS in 1998.

NCCOS Staff Accolades

The unprecedented level of recognition of NCCOS employees and contractors in FY 2006 attests to NCCOS' success in attracting, enabling, and retaining outstanding scientific, managerial, technical, and administrative personnel.

DOC, NOAA, and NOS Awards:

Gordon Thayer and Teresa McTigue received U.S. Department of Commerce (DOC) Bronze Medals for developing a precedent-setting manual on how to monitor coastal habitat restoration efforts in a scientifically-sound and cost-effective manner.

Ada Otter received a DOC Bronze Medal for forging a historic, long-term partnership with Mexico to increase the safe marine transportation of goods and services, including key energy shipments, in shared boundary waters.

Alicia Jarboe received a NOAA Administrator's Award for leadership in improving business operating practices in the NCCOS science agenda, achieving greater consistency in performance plans, and managing an appropriations reduction of \$25 million from FY 2005-06.

Michael Dowgiallo and Felix Martinez received NOAA Administrator's Awards for leadership in creating a Caribbean Coral Reef Institute which conducts strategic research for improved resource management of coral reefs.

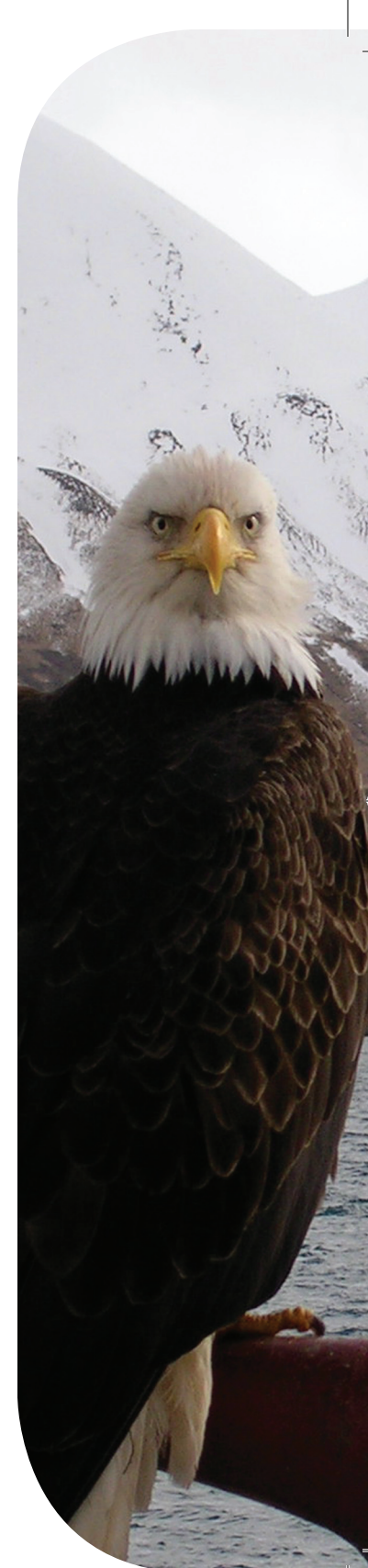
John Christensen was named an Employee of the Year in NOAA's National Ocean Service (NOS) for leading the National Coral Reef Ecosystem Monitoring Program, for helping reinvent the NCCOS' Contaminant Impacts Team, and for leading a team of NOAA and non-NOAA scientists to conduct a biogeographic assessment of the Channel Islands National Marine Sanctuary.

Karen Bauersfeld was also named a NOS Employee of the Year for her extraordinary accomplishment as lead budget officer for NCCOS' Center for Coastal Environmental Health and Biomolecular Research, Cooperative Oxford Laboratory, and Hollings Marine Laboratory, which encompasses \$23.5 million annually, and for outstanding contributions throughout her 37 years of Federal service.

Teresa McTigue received a NOS Equal Employment Opportunity and Affirmative Action Award for being an active participant in and advocate of activities that directly support a diverse and supportive NOS work force.

Mark Fonseca received a NOS Peer Recognition "Rafting" Award for his outstanding efforts in guiding NCCOS and NOS' Office of National Marine Sanctuaries through their most successful year of cooperative science.

Jay Lewis, Dorothy Howard, and Austin Farley (retired), along with their research partners, received NOS Unit Citation Awards for the discovery of the microscopic parasites *Cryptosporidium* in U.S. commercial shellfish and for completing the first study to measure levels of the parasites in shellfish throughout the Atlantic and Gulf Coast regions.





FISCAL YEAR 2006 ACCOMPLISHMENTS

Ecological Forecasts

NCCOS conducts and supports scientific research to forecast future environmental conditions so managers can select the best ecosystem management strategies. Similar to an economic or weather forecast, an ecological forecast uses science to predict the potential consequences of different actions and helps society plan for the future.

Remarkable Accuracy of 2006 “Dead Zone” Forecast Validated Use as Effective Management Tool

Based on modeling and monitoring efforts supported by NCCOS, the actual size of the “dead zone” off the coasts of Louisiana and Texas was less than one percent from the forecasted size. In July 2006, NCCOS and its partners at Louisiana State University and Louisiana Universities Marine Consortium predicted the dead zone – an annual event causing marine invertebrates, fish, and plants to die from a lack of oxygen – would be 6,700 square miles, an area about half the size of the State of Maryland, and larger than the average size of the dead zone since 1990. Results from an August 2006 cruise found that the actual size of the dead zone was 6,662 square miles. The scientists used nitrate loads from the Mississippi and Atchafalaya Rivers provided by the U.S. Geological Survey to model the dead zone size. With continued validation of the model using observed data, scientists are improving such operational forecasts and strengthening NOAA’s predictive capabilities for ecosystem management.

Photo credit: Florida Fish and Wildlife Conservation Commission, NOAA

Birth Rate of Endangered Right Whales Forecasted, Made Available On Web Site

Upon discovery that a “chain reaction” of atmospheric and oceanic changes ultimately affects the birth rate of right whales, NCCOS-supported scientists at the University of Maine and the Gulf of Maine Research Institute forecasted the birth rate of North Atlantic right whales for 2006 and made it available on the Gulf of Maine Ocean Observing System web site. The web site provides an interface to identify natural versus human-caused declines in the right whale population. In addition, the forecast may provide early warnings of ecological problems in the Gulf of Maine. With only 300-350 individuals alive today, the North Atlantic right whale is critically endangered, and reproductive failure is one of the factors cited as contributing to the population’s inability to recover. While the 2006 forecast has not been validated yet, these forecasts have been accurate for all but three years from 1982 to 2003. More information on the forecast is available at: <http://www.gomoos.org/environmentalprediction/index.html>.

New Monitoring Capability Improves Forecasting of Harmful Algal Blooms in Florida

Two new underwater gliders were deployed in April 2006 to detect blooms of the toxic algae, *Karenia brevis*, commonly known as “Florida Red Tide.” A collaboration between NCCOS and the Mote Marine Laboratory, the two NOAA gliders joined a third glider funded by the State of Florida to begin monitoring for the harmful algae using an instrument called the BreveBuster, a cylindrical device that optically detects *Karenia brevis* blooms. Use of the BreveBuster on gliders was developed with NCCOS funding, and the current glider project is part of a larger program to improve NOAA’s contributions to the Integrated Ocean Observing System (IOOS) by

demonstrating effective new monitoring capabilities. The gliders have no propellers and are capable of remaining deployed unattended for up to three weeks, and are expected to provide key data on bloom locations that will improve the accuracy of NOAA's operational Harmful Algal Bloom Forecast System for Florida. This real-time data allow for early detection and continuous monitoring of bloom events, ultimately improving event response and mitigation, and enabling industries and beachgoers to better prepare for bloom effects. Blooms of *Karenia brevis*, which routinely occur in Florida, can cause human respiratory distress, toxic shellfish, animal mortality, water discoloration, massive fish kills, and loss of tourism revenues. More information on BreveBusters and the real-time data from these instruments is available at: <http://coolgate.mote.org/socool/>.

Spring Pink Shrimp Harvest Forecasts to Improve with Results of 2006 Harvest

While NCCOS and its NOAA partners have been successful over the past two decades in estimating the North Carolina pink shrimp harvest, the 2006 harvest was substantially below the forecast level. From February to July 2006, the pink shrimp harvest was only 16.9 metric tons, far below NOAA's model prediction based on the lowest temperatures experienced by the shrimp during the vulnerable overwintering period in North Carolina's estuaries. Based on the results of the 2006 harvest, it appears that factors beyond temperatures are determining spring pink shrimp harvests, including reduced fishing effort due to low market prices and high fuel costs, poor recruitment following previous low temperature years, or shifts in ecological conditions such as increased competition with other shrimp species. NOAA scientists will use these new findings to improve the model and NOAA's predictive capabilities to assist fishers in planning their fishing efforts.



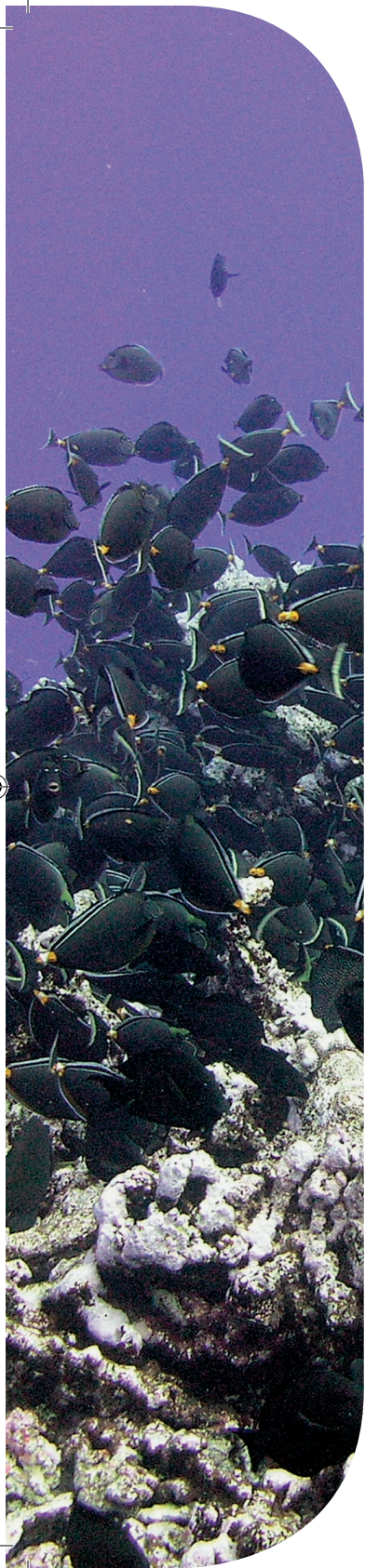


Photo credit: Robert Schroeder

Ecological Assessments

NCCOS conducts and disseminates ecological assessments to help guide the use and protection of coastal and ocean resources using an ecosystem approach.

NCCOS and NMSP Collaboration Results in Unprecedented Biogeographic Assessment of Offshore Southern California

In November 2005, NCCOS and NOS' National Marine Sanctuary Program concluded a three-year collaboration to compile and assess information on the distribution of marine flora, fauna, and physical oceanography surrounding the Channel Islands National Marine Sanctuary off the coast of Southern California. The resulting report – *A Biogeographic Assessment of the Channel Islands National Marine Sanctuary* – represents one of the most comprehensive efforts undertaken to understand large-scale marine biogeography. The information will help coastal managers make spatially explicit decisions, and will support regional research and education activities. The assessment report and other related materials are available at: http://ccma.nos.noaa.gov/ecosystems/sanctuaries/chanisl_nms.html.

Debris Assessment Guided Reef Monitoring, Cleanup in National Marine Sanctuary

NCCOS scientists used results from an assessment of marine debris accumulation at Gray's Reef National Marine Sanctuary off the coast of Georgia to develop a strategy for long-term monitoring and cleanup. Based on information from field surveys conducted in 2004 and 2005, the scientists described the types, distribution, and

abundance of debris in the Sanctuary and assessed patterns in relation to human use, bottom type, and physiographic characteristics of the sea floor. They also mapped predicted debris densities, which guided selection of sites for the June 2006 "Sweep the Reef, Sweep the Beach" World Oceans Day Cleanup. On June 11, three charter boats transported volunteer divers who removed debris from the target areas and collected information on the impacts of debris on benthic organisms. More information about Gray's Reef National Marine Sanctuary is available at: http://ccma.nos.noaa.gov/ecosystems/sanctuaries/grays_nms.html.

Assessment of Copper Concentrations Supports Evaluation of Management Actions Affecting Local Waterways

Using long-term monitoring data from its Mussel Watch Project, NCCOS scientists found that most of the higher copper concentrations measured in oysters and mussels in populated areas stem from human uses of copper rather than from natural sources. Although no overall national temporal trend in concentrations was found, the scientists attributed the increase to the use of copper-based anti-fouling paints that are replacing the now-banned paints that used tributyltin. The results, published in the October 2005 issue of the journal *Marine Chemistry*, help water quality managers examine local copper concentrations in the context of these national observations and support management decisions to determine the sources of copper affecting local waterways.

Access to Cutting-edge Information

To help NOAA fulfill its vision of an informed society making the best social and economic decisions, NCCOS shares its knowledge with stakeholders in a timely and consistent manner.

NCCOS Fulfills Need for Nutrient and Coliform Information with Publicly-accessible Database

Realizing that many available reports were difficult for the public to obtain, NCCOS researchers developed a database of nutrient and fecal coliform loadings available to coastal managers, researchers, and the public. The information, released in November 2005, will help estimate and reduce water quality impacts from nutrients and fecal bacteria, which are among the most commonly-cited causes of degraded water quality in the U.S. The searchable database also includes runoff values for other contaminants as well as bibliographic references so users can obtain additional information about the data. The database, which contains over 1,700 data points, is available at: <http://www.chbr.noaa.gov/ncl/>.

Land-based Threats to Marine Resources Identified in NCCOS Summit-to-Sea Data, Products

Geospatially-referenced data from NCCOS' Summit-to-Sea Project – a study of the linkages among terrestrial watershed characteristics, erosion, sediment transport to coral reefs, and changes in

the marine environment – were made available to coastal managers online in May 2006. The data include all of the raw data, derived products, and model results evaluating the land-based threats to coral reef ecosystems in Puerto Rico and the U.S. Virgin Islands. This information helps resource managers identify areas for improved watershed management as well as vulnerable coral reef ecosystems for monitoring and conservation efforts. The data and information about the database are available at: http://ccmaserver.nos.noaa.gov/ecosystems/coralreef/summit_sea2.html.

New NCCOS Web Site Presents Risks from Pharmaceuticals in the Environment

In August 2006, NCCOS and NCCOS-funded scientists at the University of South Carolina unveiled a new web site providing information about the risks that pharmaceuticals pose to aquatic organisms, as pharmaceuticals are frequently discharged from sewage treatment plants unaltered and then enter aquatic environments. This web site provides useful information about the risks associated with their introduction into aquatic environments. Information on more than 300 drugs, including the top 200 pharmaceuticals prescribed in the U.S., along with additional antimicrobial and antilipemic (which regulate excess fats in the blood) compounds, is included on the website. This risk assessment information is available at: <http://www.chbr.noaa.gov/peiar>.

Photo credit: Teresa McTigue

Users can rank pharmaceuticals by risk factors such as toxicity and environmental concentrations to highlight pharmaceuticals threatening aquatic organisms.

— Emily Cooper, NCCOS' Center for Coastal Environmental Health and Biomolecular Research



Photo credit: Jean Kenyon

NCCOS Meets Needs of GIS Users for Updated Habitat-delineating Software

At the request of users of geographic information system (GIS) mapping software, NCCOS updated a software tool that rapidly and more accurately delineates habitats by visually interpreting geographically-referenced images from aerial photographs, satellite images, and side-scan sonar images. Created to be used in conjunction with privately-developed software, it is an excellent example of public-private partnering and resource sharing for environmental planning and management. Since its development in 2001, the tool has been downloaded over 2,500 times for use in marine, terrestrial, and educational applications, and was incorporated into NOAA's "Remote Sensing for Spatial Analysts" course. The Habitat Digitizer Extension can be downloaded at: <http://ccma.nos.noaa.gov/products/biogeography/digitizer/welcome.html>.

New Data Portal Helps Coastal Managers Determine Status and Trends of Chemical Contamination

NCCOS helped coastal managers determine the status and trends of chemical contamination in U.S. waters by announcing a new data portal in May 2006. The data, from NOAA's National Status and Trends—Mussel Watch Project, encompass approximately 100 chemical contaminants from 290 sites in U.S. coastal and Great Lakes waters. Users can download, graph, and map chemical concentrations to determine environmental change and make informed and timely decisions in response to extreme natural events and restoration efforts. NOAA's National Status and Trends Program builds interoperability with other large-scale monitoring programs into its databases, including the future National Water Quality Monitoring Network and IOOS. The data and additional information on the Mussel Watch Project are available at: http://www8.nos.noaa.gov/cit/nsandt/download/mw_monitoring.aspx.

National Highlights

NCCOS and Partners Complete Design for National Water Quality Monitoring Network

NCCOS played a lead role in designing a National Water Quality Monitoring Network that will provide monitoring data from the beginning of the watershed to the open ocean, and integrate this data with river, groundwater, and atmospheric information. The network design also connects water quality with contaminant sources, links to IOOS, and ensures data quality and integrity. The data will be used to provide a nationwide assessment of the status and trends of the Nation's waters and help develop a more robust Global Earth Observing System of Systems (GEOSS). NOAA and its Federal, state, tribal, regional, local, and university partners received accolades from the White House-Office of Science and Technology Policy for developing such an innovative design, completing it on time, and fulfilling an action item in the U.S. Ocean Action Plan. NCCOS and its partners continue to work with the water quality monitoring community to ensure that the network's design is beneficial and complementary to existing monitoring efforts. More information about the National Water Quality Monitoring Network is available at: <http://acwi.gov/monitoring/network/index.html>.


Multi-Agency Human Dimensions Research Strategy Developed to Mitigate Impacts from Harmful Algal Blooms

In FY 2006, NCCOS coordinated the development of a multi-agency strategy for human dimensions research critical to mitigate the environmental, public health, and socioeconomic impacts of HABs. The strategy – *Harmful Algal Research and Response: A Human Dimensions Strategy* – includes research objectives and example projects to improve communication of scientific information to at-risk communities; identify susceptible human populations; improve monitoring, documentation, and response to algal toxins in drinking and recreational waters; assess sociocultural and economic impacts; and help fulfill other priorities. The research framework is already being used by state, Federal, and international resource management agencies and will help implement the Harmful Algal Bloom and Hypoxia Amendments Act of 2004 and the National Plan for Algal Toxins and Harmful Algal Blooms. The report is available at: <http://www.coastalscience.noaa.gov/stressors/extremeevents/hab/HDstrategy.pdf>.

Photo credit: Robert Schwemmer

This report recommends human dimensions research needed to protect the health, livelihood, and culture of communities affected by harmful algal blooms.

— Marybeth Bauer, NCCOS
Headquarters



The Navy's marine mammal fleet could be harmed by HAB toxins, so identifying toxin levels present during blooms can help reduce risks to this susceptible population.

— *Tod Leighfield, NCCOS' Center for Coastal Environmental Health and Biomolecular Research*

Volunteer Monitoring Network Expanded from Coast to Coast

The geographic extent of NCCOS' Southeast Phytoplankton Monitoring Network dramatically increased when sampling sites in both the Hawaiian Islands and the U.S. Virgin Islands were added in August 2006. Volunteers in Hawaii and the U.S. Virgin Islands are now collecting benthic samples to check for toxic dinoflagellates responsible for ciguatera fish poisoning. This NOAA-sponsored program serves to increase awareness of issues related to harmful algae, directly involves volunteers in coastal stewardship, and offers unique educational opportunities to volunteer groups. Fiscal Year 2006 marked the Network's sixth year of collaboration with 60 groups monitoring more than 72 sites along the coasts of North Carolina, South Carolina, Georgia, and Florida. More information about the Southeast Phytoplankton Monitoring Network is available at: <http://www.chbr.noaa.gov/pmn>.

Health of U.S. Navy's Marine Mammal Fleet Safeguarded Using NCCOS Analyses

At the request of the U.S. Navy, NCCOS scientists assessed the impact of a persistent domoic acid-producing HAB near animal holding areas for the Navy's marine mammal fleet in San Diego, California. Domoic acid concentrations were below the known effect level in the marine mammals and at trace levels in their food sources. The Navy uses

bottlenose dolphins and California sea lions to protect ports and Navy equipment, and locate potentially dangerous sea mines. The NCCOS analyses were part of a toolbox being developed by NOAA in collaboration with the Navy to assess the impacts of algal toxins on the health of their marine mammal fleet. More information about NCCOS' efforts to protect marine mammals from biotoxins is available at: <http://www.chbr.noaa.gov/default.aspx?category=mb&pageName=art>.

DNA Barcode Helps Coastal Managers Accurately Identify Toxic Algal Species

NCCOS scientists and their partners at Duke University, the Virginia Institute of Marine Science, and the Florida Marine Research Institute produced a deoxyribonucleic acid (DNA) barcoding system to discriminate between morphologically-similar toxic and non-toxic species of phytoplankton. As many co-occurring species are very similar in appearance, DNA sequences can be used to distinguish among the species. This new system enables environmental managers to unambiguously identify harmful algae in field and laboratory studies and improve their response to protect coastal resources and human health. Development of this new system also reflects NOAA's commitment to cooperative research endeavors with external partners. These findings were published in the March 2007 issue of the *Journal of Phycology*.

Photo credit: Greg McFall

Prozac, Antimicrobial Compound Found to Harm Aquatic Species in NCCOS Risk Assessments of Pharmaceuticals

NCCOS scientists found triclosan, an antimicrobial compound in common household items such as toothpaste, significantly reduced cell densities of the marine phytoplankton species *Dunaliella tertiolecta* at concentrations that have been measured in the environment. This finding highlights the importance of considering lower trophic level impacts in the environmental risk assessment process. In addition, a National Institute of Standards and Technology researcher at NCCOS' Hollings Marine Laboratory found that exposure to Prozac, one of the most prescribed antidepressants, caused a premature release of larvae in an aquatic mussel, which reduced larval viability and may endanger the survival of this and other species. Prozac and triclosan may be transported into waterways via wastewater treatment systems and join other contaminants to cause cumulative impacts to individual species and ecosystems. NCCOS scientists are continuing these studies to aid future management decisions regarding pharmaceutical disposal practices.

Regional Highlights

Northeast

Emergency NCCOS Funding Helped Protect Human Health and Local Economies in Maine from Harmful Algal Bloom

During the 2006 "red tide" event in New England, NCCOS provided emergency funds to help the State of Maine extend their monitoring of a HAB in Casco Bay for five additional weeks. As a result of the monitoring program, the Maine Department of Marine Resources was able to keep hundreds of acres of shellfish beds open during the bloom. State resource managers placed bags of mussels offshore of commercially and recreationally harvested shellfish beds where they accumulated paralytic shellfish poisoning toxins from the *Alexandrium* algae in the water, thereby providing early warnings of shellfish toxicity. Due to the success of the monitoring program in 2006, the State of Maine has decided to fund this type of monitoring in the future. From 1998 through 2006, NCCOS funded \$11 million for research on *Alexandrium* in the Gulf of Maine to improve HAB detection, prediction, and management capabilities in the region. More information on NCCOS' role in responding to the 2006 New England Red Tide is available at: http://www.cop.noaa.gov/news/fs/ne_hab_200605.html.

Maine's novel and cost-effective monitoring program during the 2006 bloom resulted in both immediate and long-term benefits for local communities.

— Quay Dortch, NCCOS' Center for Sponsored Coastal Ocean Research

Photo credit: Estrella Marca



Photo credit: Robert Schroeder

Newly Operational Forecast Model Helps to Identify Seagrass Restoration Sites in Maryland

The Wave Exposure Forecast Model developed by NCCOS scientists became operational in December 2005 and is being verified by the Maryland Division of Natural Resources to help identify seagrass restoration sites. The model simplifies the state's current protocol for targeting restoration sites and was found to be consistent with wave gauge measurements from the Chesapeake Bay nine out of ten times. Restoration of seagrass beds will help resource managers better understand the importance of these habitats to the long-term support of fish populations, as an estimated three-quarters of the Nation's harvestable marine species are dependent on estuarine habitats such as seagrass beds for food, shelter, migratory routes, and/or spawning grounds at some point in their life cycle.

Efforts to Save Endangered Right Whales Benefit from New Sampling Strategy

Scientists in NCCOS and at the New England Aquarium employed a unique method to assess the reproductive health of North Atlantic right whales by using specially trained dogs to find the whales' fecal material at their feeding grounds in the Bay of Fundy and then testing it for algal biotoxins. Sampling restrictions associated with endangered species make fecal material a valuable source of information

on the whales' diet, stress and reproductive hormone levels, and toxin exposure. This method is now one of several tools being used to understanding why there are only 300-350 North Atlantic right whales remaining and what must be done to save the population. The results, published in the January 2006 issue of the journal *Marine Ecology Progress Series* and shared with the general public at: http://www.seaweb.org/secure/newsletter-ocean-update.php?year=2006#Vol11No5_3, are providing information essential to support management and conservation efforts for this endangered species.

Southeast

Model of St. Lucie Estuary Aiding Water Quality Management in Florida

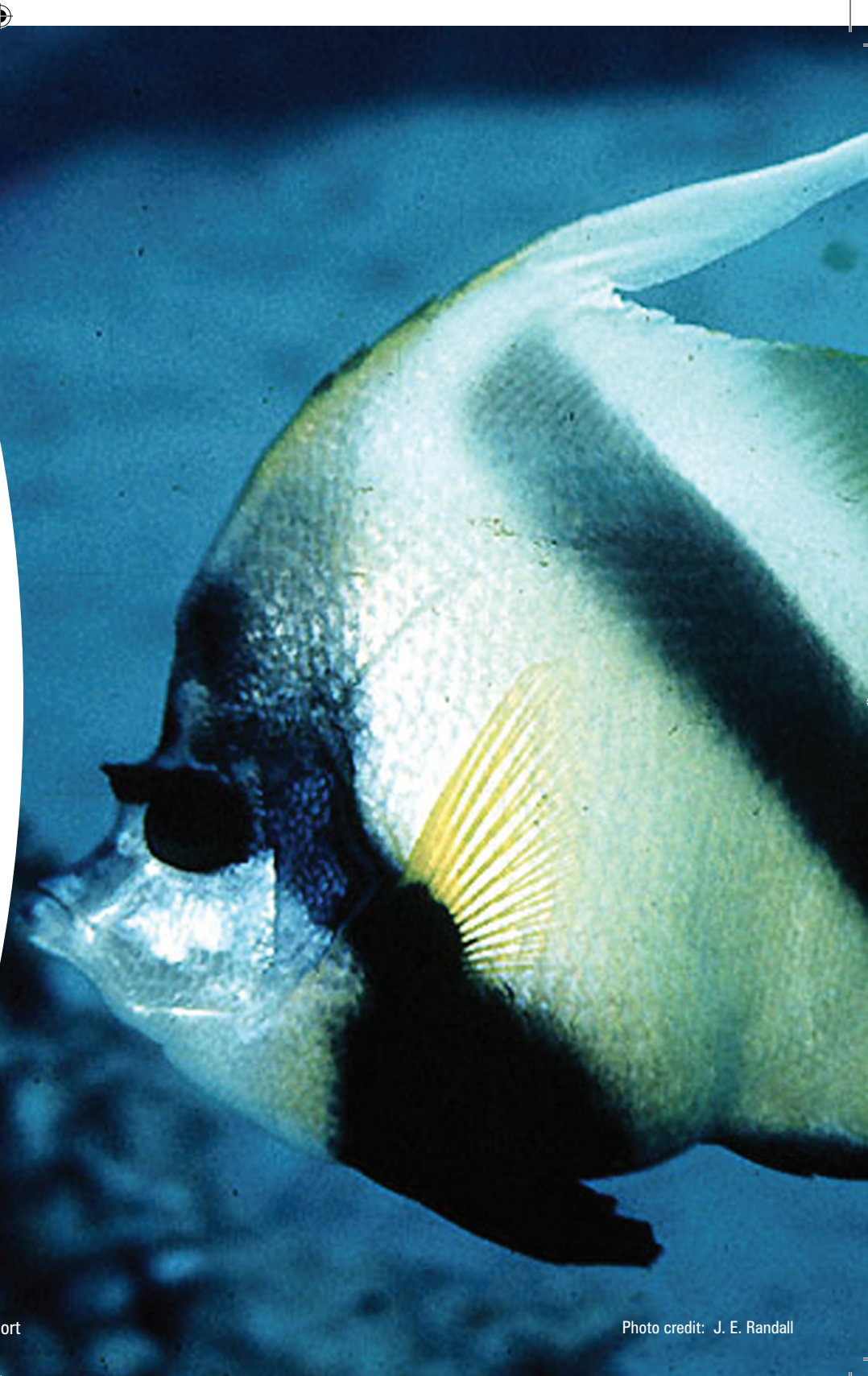
Based on their previous findings on the spatial extent and severity of copper contamination in Florida's St. Lucie Estuary, NCCOS and its partners created a hydrodynamic model to examine the transport and fate of copper in the estuary. The South Florida Water Management District and other resource management agencies in Florida will use the model to help manage ecological integrity and water quality in this complex, but highly altered estuarine system. The model is a product of several long-term cooperative studies with NOS, NOAA Fisheries' Southeast Fisheries Science Center, and the State of Florida.

NCCOS Research Helped Allay Public Fears Concerning Fish Lesions in North Carolina, Florida

To help coastal managers provide the public with timely and accurate information about skin ulcers that often coincide with large fish kills, NCCOS scientists developed molecular analysis methods and used them to help the North Carolina Division of Water Quality show that the water mold *Aphanomyces invadans*, a species that is not toxic or indicative of environmental pollution, caused most of the observed ulcers in the Neuse and Pamlico Rivers. NCCOS scientists also helped the Florida Fish and Wildlife Conservation Commission evaluate fish lesions to help allay fears concerning lesion events. This research was published in the February 2006 issue of the journal *Applied and Environmental Microbiology* and in the January 2007 issue of the *Journal of Aquatic Animal Health*.

NCCOS Bulletin Readied Managers in Florida to Address Possible Invasion of Red Sea Bannerfish

In July 2006, NCCOS issued an Invasive Species Bulletin warning of the potential for the non-native Red Sea bannerfish (*Heniochus intermedius*) to survive and breed in new locations. The Red Sea bannerfish is native to the Red Sea, but is sold in the U.S. as a saltwater aquarium fish and is one of several exotic aquarium fish species that have been photographed or captured in recent years living on reefs off southern Florida. The bulletin was developed in response to Red Sea bannerfish sightings off Palm Beach, Florida and a subsequent alert issued by the U.S. Geological Survey with which NCCOS is collaborating to provide information and tools for aquatic resource managers dealing with aquatic invasive species. More information on Red Sea bannerfish is available at: <http://coastalscience.noaa.gov/stressors/invasivespecies/RedSeaBannerfish.html>.





Lionfish distribution and density have increased faster than we originally anticipated. We expect increasing numbers and continued geographic expansion, especially at the southern extent of the range.

— Paula Whitfield, NCCOS' Center for Coastal Fisheries and Habitat Research

NCCOS Studies on Increasingly-abundant Invasive Lionfish Shape New Fishery Ecosystem Plan, Spur Volunteer Collection of Specimens

As part of their ongoing research on the Indo-Pacific lionfish, NCCOS scientists reported densities of the venomous tropical invaders off the North Carolina coast were almost twice as high as observed levels from the previous year, with four locations exceeding previous record densities. These findings are helping the South Atlantic Fishery Management Council develop a new regional fishery ecosystem plan as they consider how lionfish may negatively impact native fish communities and hamper management of grouper/snapper species. As part of a collaborative study between NCCOS and the Reef Environmental Education Foundation, collection kits were distributed to divers who volunteered to collect samples of lionfish year-round from the southern limit of the species' current distribution in the Atlantic. The low-cost, year-round collections will help NCCOS scientists develop ecological forecasts of lionfish density and distribution in U.S. coastal waters and help manage this invader, which was first reported off the North Carolina coast in August 2000.

Coral Reef Monitoring and Management in Southeast Florida Aided by Large-scale Mapping Project

Answering the call in the U.S. National Action Plan for comprehensive coral reef maps, the NCCOS-sponsored National Coral Reef Institute developed detailed maps of portions of reefs in Southeast Florida and part of the U.S. Caribbean from 0-100 feet. The maps have been used by managers and researchers – including the Broward County Environmental Protection Department – for research, monitoring, and management efforts. The scientists used

aerial photographs, light detection and ranging (LIDAR) data, multibeam sonar data, and laser and multibeam bathymetry to develop the maps, which have been used to respond to oil spills, identify fish habitat, plan/evaluate offshore construction, assess impacts from ship groundings, and monitor dredging and beach renourishment projects.

Gulf of Mexico

Gulf of Mexico's "Dead Zone" Negatively Impacted Health and Size of Shrimp

NCCOS-supported researchers at Duke University determined that the 2005 seasonal hypoxic (low oxygen) zone in the Gulf of Mexico negatively impacted the health and size of brown shrimp, the Gulf's highest-valued commercial species, resulting in a 25% habitat loss for shrimp, a 5-20% decrease in shrimp growth rate, lower lipid levels and energy content, and smaller body size. Although shrimp can escape low oxygen waters, the researchers found that shrimp avoidance of the hypoxic zone causes them to aggregate on the periphery of the zone, where temperatures are suboptimal for their growth. These findings represent an important contribution to understanding the impacts of the hypoxic zone on a vital natural resource of the Gulf of Mexico.

NCCOS Activity Books Educate, Entertain Children Displaced by Hurricane Katrina

NCCOS responded to multiple requests for activity books for children displaced by Hurricane Katrina by sending more than 2,500 activity books to shelters and public school systems. The books introduce children (grades K-5) to coastal animals and ecology and include regional

information, fun facts, drawings to color, and connect-the-dot and find-a-word games. NCCOS has created activity books on Coastal Louisiana, Coastal North Carolina, the Salish Sea, Mobile Bay, Chesapeake Bay, Hawaii, and the Arctic and Antarctic as part of its efforts to foster environmental stewardship in the next generation of citizens and scientists. Although not designed specifically for use in schools, the Louisiana Department of Education evaluated the Coastal Louisiana Activity Book and found that it met the state's Standards of Learning for elementary education. Copies of the regional activity books are available at: <http://www.nccos.noaa.gov/education/welcome.html>.

No Major Chemical Contamination Found in Gulf Coast Oysters after Hurricanes Katrina and Rita using Long-term Monitoring Dataset

Based on data collected at 14 Gulf Coast sites during a post-hurricane assessment and compared to 20 years of monitoring trend data from NCCOS' Mussel Watch Project, NCCOS scientists found no major indication of organic chemical contamination in oysters as a result of Hurricanes Katrina and Rita. These findings were shared with environmental and public health managers as well as concerned citizens at a session on public health and environmental impacts of Hurricanes Katrina and Rita at the 93rd annual meeting of the International Association for Food Protection in August 2006. The NCCOS study supported information presented by NOAA partners and other agencies showing no indication of contamination that would cause problems with food safety.

Caribbean

NCCOS-sponsored Research Helps Identify Marine Protected Area Boundaries, Management Needs for Puerto Rican Island

Through underwater surveys, scientists from the NCCOS-sponsored Caribbean Coral Reef Institute identified localized distribution patterns of important coral reef fish habitats around the Mona Island Natural Reserve in Puerto Rico, suggesting that designation of no-take fishing areas will be important to maintain these fish populations. The study results were presented to Puerto Rico's Department of Natural and Environmental Resources managers to help them identify boundaries and management needs for a marine protected area around the Island. The findings will also assist the Puerto Rico Commonwealth in developing strategies to protect the health of coral reef fish communities in Mona Island's marine protected areas. As Mona Island is isolated in between two biogeographical areas, healthy fish communities are essential both for population maintenance and genetic connectivity between Puerto Rico and Hispaniola.

The finding of no significant organic chemical contamination in Gulf Coast oysters after Hurricanes Katrina and Rita was good news to share with food safety scientists and concerned citizens.

— Kimani Kimbrough, NCCOS' Center for Coastal Monitoring and Assessment





Massive Coral Bleaching Event in U.S. Virgin Islands Documented by NCCOS and Partners

As part of NOAA's biannual monitoring of coral reef ecosystems, researchers from NCCOS and the U.S. National Park Service observed widespread bleaching in 21 species (53% of surveyed cover) of hard corals at Buck Island Reef National Monument in St. Croix in October 2005. Warmer water temperatures in the northeastern Caribbean may have contributed to the observed bleaching event, which was part of a larger bleaching event that occurred throughout the tropical western Atlantic. Prolonged bleaching can be lethal to corals and, along with disease and pollution, may have contributed to the loss of about 10% of the world's coral reefs within the past decade. NCCOS and its partners are continuing to monitor coral reef ecosystems to determine the overall impact of this event as well as plan and assess resource management efforts. More information on the bleaching event is available at: http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish.html.

NCCOS Study Supports Marine Protected Area Designed to Sustain Exploited Fish in South Florida

Results of a six-year study by NCCOS scientists supported management actions to include a large area and diversity of habitats within the Tortugas Ecological Reserve. The scientists documented an increase in exploited reef fish abundance in reserve habitats compared to unprotected areas. Their findings support the protection of open benthic habitats adjacent to reef systems that play an important role in the food web on which many reef species depend. Data from this study also confirmed that benthic primary production is the primary source of energy fueling fish production throughout the Reserve. These results, published in January 2006 as a NOAA Technical Memorandum, are available at: <http://www.ccfhr.noaa.gov/data/ploneexfile.2006-06-29.9265805741%0A>.

Great Lakes

NCCOS Completed 15th Year of Monitoring Chemical Concentrations, Assessing Environmental Changes in Great Lakes

September 2006 marked the 15th year anniversary of NCCOS scientists collecting zebra mussel samples from the Great Lakes as part of an ongoing effort to document changes in chemical contamination in these bivalves. In 2006, sediments were also collected and will be analyzed for contaminants. The analysis results will provide important long-term data needed to assess contaminant trends and overall environmental quality in the Great Lakes. Staff from NOAA's Great Lakes Environmental Research Laboratory in Muskegon, Michigan assisted in the sample collection and provided valuable logistical support. This sampling effort is part of NCCOS' Mussel Watch Project, which completed its 21st year of sampling for environmental contaminants in coastal waters nationwide. The results were published in Volume 2, Issue 3 of the *American Journal of Environmental Sciences*.

NCCOS-funded Researchers to Improve Identification and Response to Freshwater Harmful Algal Blooms in Lakes Erie, Ontario, and Champlain

To address the myriad of bloom-related problems faced by humans and animals in the Great Lakes region, NCCOS-funded scientists are integrating satellite imagery, conventional HAB detection methods including transport models, and novel quantitative molecular tools to detect, assess, predict, control, and mitigate HAB events. In addition, the scientists are coordinating with public health

and water quality managers to raise awareness about HAB impacts and the need for sustained HAB monitoring in the Great Lakes. As toxins produced by blue-green algae (cyanobacteria) present serious, even fatal, threats to animal and human health, NCCOS and its partners are developing a Great Lakes HAB Forecast System using the integrated technologies and connecting their Great Lakes data collections to the IOOS. NCCOS' partners in this effort are at the State University of New York, University of Vermont, Western Michigan University, University of Tennessee, and New York State Sea Grant. More information is available at: <http://www.esf.edu/merhab/index.asp> and <http://ccma.nos.noaa.gov/stressors/extremeevents/hab/HABForecast.html>.

Northwest

Quileute and Quinault Tribes' Traditional Shellfish Harvests Safer with New NCCOS Tool

NCCOS scientists working with the Quileute and Quinault Tribal Nations in Washington State developed a rapid, cost-effective detection method for domoic acid, an algal toxin that can accumulate in shellfish, poison humans, and kill fish, seabirds, and marine mammals. The method was used at tribal laboratories and accurately determined contamination levels in shellfish within four hours, thereby expediting decisions of if/when to close affected shellfish areas that previously required much more time as samples from shellfish beds in remote areas had to be shipped to the health department in Seattle for analysis. The new technology, called enzyme-linked immunosorbent monoclonal antibody assay, was developed in collaboration with NOAA Fisheries' Northwest Fisheries Science Center in Seattle, Washington and was shared with coastal managers and scientists in

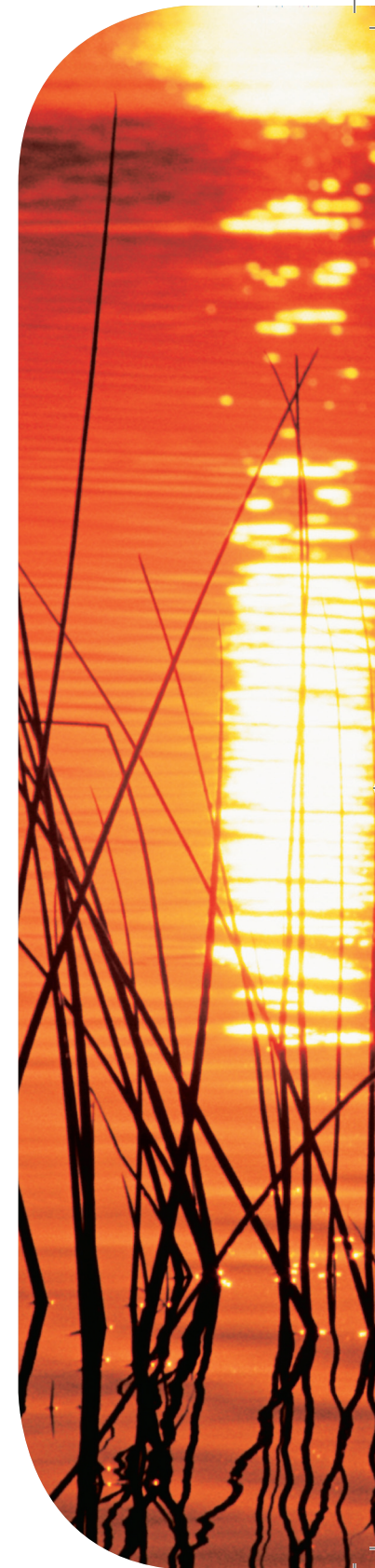




Photo credit: Laurel Jennings

California, Oregon, and Washington via the Olympic Region Harmful Algal Bloom Program. Coastal managers in Canada and the Chesapeake Bay have also expressed interest in using this technology, as domoic acid-producing organisms have been reported in these areas.

New Mussel Watch Project Site Extends Monitoring Capabilities in Washington State
NCCOS and its NOS partners – NOS' Office of Response and Restoration, the Snohomish County Marine Resources Committee, and the Stillaguamish Tribe – established a new national Mussel Watch Project site in Port Susan, Washington. The Stillaguamish Tribe expressed great interest in establishing a contaminant monitoring site in their region, and NOAA agreed to analyze samples if a permanent sampling site was established as part of its National Status and Trends Program. NOS and Tribal biologists began sampling the site in February 2006, shipping bivalve samples to NCCOS' contract laboratories for chemical contaminant analysis. This collaborative effort added an additional Mussel Watch Project site to the system of more than 250 sites monitored for chemical contaminants.

NCCOS-sponsored Research Helps Improve Salmon Fishery Management in the Pacific Northwest

Research conducted by the NCCOS-sponsored Global Ocean Ecosystem Dynamics (GLOBEC) Program on how salmon react to ocean conditions explained why fewer spring Chinook are returning to the Columbia Basin. The GLOBEC researchers predicted that less than favorable ocean conditions over the next few years will result in lower returns of salmon in the Pacific Northwest than were previously expected. Using this new insight, indicators of

ecological change are being developed to assist fisheries management. The GLOBEC Northeast Pacific Program examines the effects of climate variability and change on the distribution, abundance, and production of marine animals, and develops models to explain and forecast ecosystem dynamics and responses. More information about the indices is available at: <http://www.nwfsc.noaa.gov/research/divisions/fed/oeip/g-forecast.cfm>.

Southwest

Identification of New Species of Toxic Algae in Hawaiian Coral Reefs Helps Protect Human Health

In June 2006, scientists from NCCOS and the University of Hawaii announced the identification of a new species of toxic algae found in coral reefs in Hawaiian coastal waters. The new algal species was abundant in coral reefs known to contain species of fish at risk for consuming the toxic algae and then causing human health issues, including nausea, vomiting, and neurological symptoms such as tingling fingers or toes. The identification and description of this new species will help coastal managers better understand different toxic species associated with coral reefs and the potential human health risks associated with these species. The identification and description of this new species, which was named *Ostreopsis tholus* based on its morphological characteristics, will be published in the international journal *Botanical Marina*.



Photo credit: M. M. Johnson

California Sea Lion Population Assessed for Algal Toxin Risk Based on NCCOS Research

NCCOS and The Marine Mammal Center identified domoic acid, an algal toxin, as a cause of reproductive failure in California sea lions, which indicated for the first time possible population-level consequences of repeated HAB events to marine mammals. Domoic acid producing-algal blooms tend to occur along the California coast during months immediately prior to the sea lion breeding season, and since 1998, hundreds of mostly female California sea lions have stranded alive along the coast with clinical signs of domoic acid poisoning. Pregnant females intoxicated with domoic acid frequently abort or give birth to stillborn or abnormal young that fail to survive, as research has shown that the toxin crosses the placenta and can therefore affect fetal development. The research results, published in the July 2006 issue of the journal *Marine Mammal Science*, prompted a population risk assessment by the joint NOAA Fisheries /NOS Marine Animal Health Program and will be used to improve management plans for affected marine mammals.

International Highlights

Early Warnings of Harmful Algal Blooms in South Korea Improved with NCCOS Technology Transfer

In May 2006, NCCOS transferred to South Korean scientists an automated system to detect the country's most problematic HAB organism, *Cochlodinium*. The molecular-based test detects this fish-killing species at low, pre-bloom concentrations, thereby providing South Korean coastal managers with an early warning of these economically devastating events and allowing more effective mitigation of their widespread impacts on aquaculture farms. The technology was transferred through a Joint Project Agreement between NOAA and the Korean Ministry of Maritime Affairs and Fisheries.

NCCOS-coordinated Manual Adopted by The Nature Conservancy for Habitat Restoration Worldwide

The precedent-setting manual on how to monitor coastal habitat restoration efforts in a cost-effective and scientifically-sound manner was selected in FY 2006 for use by The Nature Conservancy. The manual will help guide restoration practitioners involved with The Nature Conservancy's Global Marine Initiative in 22 countries and every coastal U.S. state when planning restoration monitoring methods. Coordinated by NCCOS and developed with NOAA Fisheries' Restoration Center and NOAA Research's Great Lakes Environmental Research Laboratory, the manual already serves as a standard reference nationally and internationally, and is being used as a text book in advanced high school and university science courses. The *Science-Based Restoration Monitoring of Coastal Habitats*



Photo credit: Robert Schwemmer



Photo credit: Claire Johnson

manual fulfills a legislative mandate under the Estuary Restoration Act and is available at: http://coastalscience.noaa.gov/ecosystems/estuaries/restoration_monitoring.html.

NCCOS-developed Technology to Monitor Harmful Algal Blooms Transferred via U.S.-China Accord

Consistent with the U.S.-China Agreement on Cooperation in Science and Technology, NCCOS scientists trained Chinese scientists to monitor HABs using molecular monitoring technology developed by NCCOS. The July 2006 training occurred at China's Institute of Oceanology, and was attended by scientists from the State Oceanic Administration and six Chinese universities and research institutes. This technology transfer improves the speed and accuracy of HAB identification and monitoring which will help protect human health and local Chinese economies dependent on aquaculture operations.



Photo credit: M. M. Johnson

Seagrass Conservation Aided in Europe, North Africa with NCCOS Ecosystem Approach

NCCOS helped scientists from North Africa and Europe integrate biological, ecological, and management aspects of Mediterranean aquatic vegetation into an ecosystem approach to seagrass conservation. Seagrasses in the western Mediterranean and nearby Atlantic coasts are experiencing heavy anthropogenic pressures causing loss of marine habitat in the region. Planning during the first International Mediterranean Seagrass Workshop in June 2006 marked the initiation of a new collaboration between NCCOS and the University of the Algarve in Portugal. Funded by the European Union, researchers at the University are collaborating with NCCOS and will focus on restoration of seagrasses in Portugal lost to commercial fishing impacts and sand loss resulting from disruption of longshore transport.

Export of Safe Seafood Products from Africa Aided by NCCOS-developed Methods and Training

In April 2006, seafood regulators in Angola, Namibia, and South Africa were trained to use new NCCOS-developed methods to test seafood products for algal toxins without using live animal testing. The increasing global opposition to seafood testing using live animals has led the International Atomic Energy Agency to provide such training in alternative testing methods to several African countries. The Agency anticipates training seafood regulators from up to ten additional countries over the next several years. Careful testing of fishery products helps protect the health of seafood consumers and support local economies through domestic and export seafood markets.

NCCOS, Russia, and Canada Collaborate to Develop Harmful Algal Bloom Monitoring Program off Russian Coast

Results of a February 2006 study of plankton and shellfish in the Kandalaksha Gulf region of the White Sea conducted by NCCOS, Russian, and Canadian scientists are serving as the foundation for establishing a HAB monitoring program for shellfish areas there. The scientists discovered toxic shellfish in that region for the first time after a July 2002 bloom of two harmful algal species, *Dinophysis acuminata* and *Dinophysis norvegica*. Analysis of the mussel tissues showed they contained three distinct marine toxins known to produce diarrhetic shellfish poisoning in humans. Once established, a HAB monitoring program will help protect coastal resources and public health. Results of this study were published in the March 2006 issue of the journal *Harmful Algae*.

Proposal to Expand Eutrophication Assessments in China Approved

Based on the results of a pilot study assessing eutrophication in four Chinese estuaries, a proposal to expand the assessments to a national level was accepted in April 2006 by the U.S.-China Integrated Coastal and Ocean Resources Management Program. The proposal – developed by scientists from NCCOS, China's State Oceanic Administration, and other European partners – was accepted along with other broad-based partnerships in integrated coastal management which will provide the basis for sound management decisions in China. The scientists helped identify potential funding sources for the multi-year assessment, and are helping develop a training component so Chinese scientists can assess waterbodies throughout the country. As a co-chair of the U.S.-China Integrated Coastal and Ocean Resources Management Program, NOAA is exercising international leadership by sharing its expertise and fostering these scientific endeavors.





Photo credit: Doug Helton

ACRONYM DEFINITIONS

- DNA – deoxyribonucleic acid
- DOC – U.S. Department of Commerce
- FY – fiscal year
- GEOSS – Global Earth Observing System of Systems
- GIS – geographic information system
- GLOBEC – Global Ocean Ecosystem Dynamics (Program)
- HAB – harmful algal bloom
- IOOS – Integrated Ocean Observing System
- LIDAR – light detection and ranging
- NCCOS – NOS' National Centers for Coastal Ocean Science
- NERR – National Estuarine Research Reserve
- NOAA – National Oceanic and Atmospheric Administration
- NOS – NOAA's National Ocean Service
- R/V – research vessel

NCCOS Headquarters is located along with its parent organization, NOAA's National Ocean Service, in Silver Spring, MD. Headquarters staff provides professional, financial, and administrative management and coordination of all NCCOS activities.

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NCCOS Center for Coastal Monitoring and Assessment (CCMA) is also located in Silver Spring, MD. CCMA staff monitors, surveys, and assesses coastal ecosystem quality, habitats, and resource distribution. CCMA manages the National Status and Trends Program, which performs long-term contaminant monitoring at over 350 estuarine and coastal sites. CCMA's monitoring and assessment studies determine how contaminant exposure and changes in coastal habitats affect the distribution and abundance of living marine resources. In addition, CCMA staff uses remote-sensing technology to evaluate estuarine and coastal environmental problems, track harmful algal blooms, and determine coastal habitat changes over time.

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NCCOS Center for Sponsored Coastal Ocean Research (CSCOR) is also located in Silver Spring, MD. CSCOR staff manages a comprehensive extramural research program to develop predictive capabilities for managing coastal ecosystems. These partnerships support long-term multidisciplinary projects to evaluate ecological effects of multiple stressors; develop forecasting tools; respond to the combined public health, economic, and ecosystem

threats from harmful algal blooms; and transition successful research into NOAA operations. CSCOR-sponsored research addresses coastal fisheries ecosystems, cumulative coastal impacts, and harmful algal blooms/eutrophication.

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NCCOS Center for Coastal Fisheries and Habitat Research (CCFHR) is located at laboratories in Beaufort, NC and Kasitsna Bay, near Seldovia, AK. CCFHR provides coastal resource managers with information to enhance recreational and commercial fishing and essential fish habitat. The Beaufort Laboratory conducts laboratory and field research on estuarine processes, biological productivity of nearshore and ocean ecosystems, dynamics of coastal and reef fishery resources, and effects of human influences on resource productivity. The Kasitsna Bay Laboratory focuses on the impacts of land and resource use on relatively pristine coastal fjord ecosystems.

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Phone: (907) 235-2400
<http://www.ccfhr.noaa.gov/About%20Us/kasitsna>

NCCOS Center for Coastal Environmental Health and Biomolecular Research (CCEHBR) is located at laboratories in Charleston, SC and Oxford, MD. CCEHBR conducts interdisciplinary

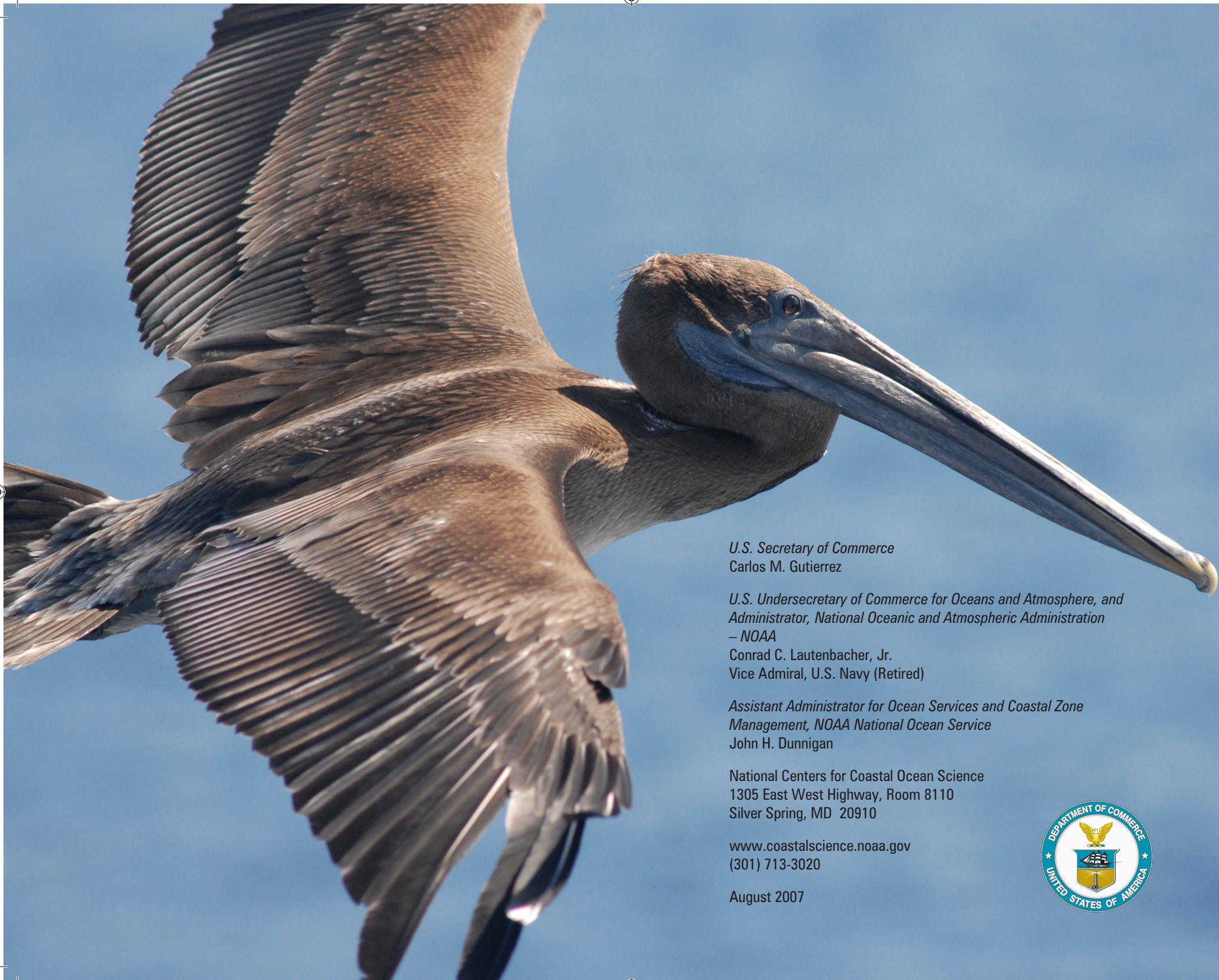
research on issues related to coastal ecosystem health, environmental quality, and related public health impacts. The Charleston Laboratory conducts chemical, biomolecular, microbiological, and histological research pertaining to human influences on marine and estuarine habitats. The Cooperative Oxford Laboratory specializes in the pathology of marine organisms and habitat restoration research.

CCEHBR
219 Fort Johnson Road
Charleston, SC 29412-9110
Phone: (843) 762-8525 • Fax: (843) 762-8700
<http://www.chbr.noaa.gov>

Cooperative Oxford Laboratory
904 South Morris Street
Oxford, MD 21654-1323
Phone: (410) 226-5193 • Fax: (410) 226-5925
<http://www.chbr.noaa.gov/default.aspx?category=oxford&pageName=Oxford%20home%20page>

NCCOS also operates a joint project agreement at the **Hollings Marine Laboratory (HML)** in Charleston, SC. The agreement focuses on the relationship between the coastal ocean ecosystem and human health, and represents an innovative way of developing scientific advancements by integrating medical and marine expertise through a diverse partnership among Federal, state, and academic organizations: NCCOS, the Medical University of South Carolina, National Institute of Science and Technology, University of Charleston, and South Carolina Department of Natural Resources. One of NOAA's Centers of Excellence in Oceans and Human Health and managed by NCCOS, HML uses state-of-the-art technologies to conduct pioneering new research examining relationships between coastal environmental health and human health.

HML
331 Fort Johnson Road
Charleston, SC 29412-9110
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<http://www.hml.noaa.gov/>



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